What is claimed is:

1. A polymer-supported metal cluster composition comprising a transition metal and a cross-linked polymer, wherein the transition metal is supported by the cross-linked polymer and the cross-linked polymer is obtained by cross-linking a cross-linkable polymer containing a hydrophobic side chain and a hydrophilic side chain having a cross-linkable functional group.

2. The composition as in claim 1, wherein the composition is prepared, in a solution, by forming a micelle wherein clusters of the metal are supported by the cross-linkable polymer and then cross-linking the cross-linkable polymer.

3. The composition as in claim 2, wherein the micelle is formed by supporting a transition metal by the cross-linkable polymer using a ligand exchange reaction between a transition metal chelate and the aromatic groups of the cross-linkable polymer.

4. The composition as in claim 2, wherein the metal clusters is 20 nm or smaller in diameter.

5. The composition as in claim 1, wherein the transition metal is at least one selected from the group consisting of palladium, cobalt, nickel, rhodium, ruthenium, iridium, gold and platinum.

6. The composition as in claim 1, wherein the transition metal is at least one selected from the group consisting of palladium, ruthenium, iridium, gold and platinum.

7. The composition as in claim 1, wherein the transition metal has zero valence.

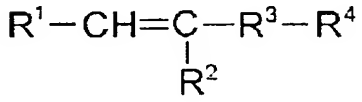
8. The composition as in claim 1, wherein the cross-linkable polymer contains a hydrophilic side chain having an epoxy group, a carboxyl group, an isocyanate group or a thioisocyanate group.

9. The composition as in claim 8, wherein the cross-linkable polymer further contains at least one type of a hydrophilic side chain having a hydroxyl group, a primary or secondary amino group, or a thiol group.

10. The composition as in claim 1, wherein the cross-linkable polymer is a polymer or a copolymer obtained by polymerizing or copolymerizing at least one type of A1) monomer having an aromatic group as a hydrophobic side chain, a hydrophilic side chain having a cross-linkable functional group and a polymerizable double bond, or a copolymer obtained by copolymerizing at least two types of monomers selected from the

groups consisting of B1) a monomer having an aromatic group as a hydrophobic side chain, a hydrophilic side chain having a cross-linkable functional group and a polymerizable double bond, B2) a monomer having an aromatic group as a hydrophobic side chain and a polymerizable double bond, and B3) a monomer containing a hydrophilic side chain having a cross-linkable functional group and a polymerizable double bond.

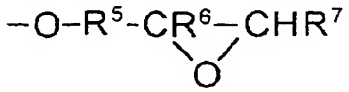
11. The composition as in claim 10, wherein the monomer having an aromatic group as a hydrophobic side chain, a hydrophilic side chain having a cross-linkable functional group and a polymerizable double bond is represented by the following chemical formula 1:



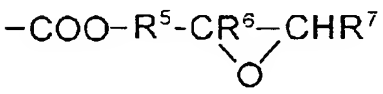
wherein R^1 is a hydrogen atom or an alkyl group having 1-6 carbon atom(s), R^2 is an aryl group having 6-14 carbon atoms, R^3 is a covalent bond, an alkylene group having 1-6 carbon atom(s), $-R^9(OR^{10})_m-$, $-R^9(COOR^{10})_n-$ or $R^9(COOR^{10})_o(OR^{10})_p-$,

wherein R^9 is independently a covalent bond or an alkylene group having 1-6 carbon atom(s), R^{10} is independently an alkylene group having 2-4 carbon atoms, m, n and p are integers of 1-10 and o is 1 or 2,

R^4 is a carboxyl group, an isocyanate group, an isothiocyanate group, a hydroxyl group, a primary or secondary amino group, a thiol group or a group represented by the following chemical formula 2 :

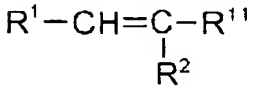


or the following chemical formula 3:



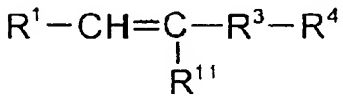
wherein R^5 is independently an alkylene group having 1-6 carbon atom(s), R^6 and R^7 are each independently a hydrogen atom or an alkyl group having 1-6 carbon atom(s), and R^6 may form a 3-6 membered ring with R^5 or R^7,

the monomer having an aromatic group as a hydrophobic side chain and a polymerizable double bond is represented by the following chemical formula 4:



wherein R^1 and R^2 are independently as defined above, R^{11} is a hydrogen atom or an alkyl group having 1-6 carbon atom(s),

and the monomer containing a hydrophilic side chain having a cross-linkable functional group and a polymerizable double bond is represented by the following chemical formula 5:



wherein R^1, R^3, R^4 and R^{11} are independently as defined above.

12. Use of the composition as in claim 1 for a catalyst in a hydrogenation reaction, a dehydrogenation reaction, an oxidation reaction, an allylic substitution reaction, a coupling reaction or a carbonylation reaction.